PATENT SPECIFICATION

DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

Improvements in or relating to Rack and Pinion Assemblies

We, CAM GEARS LIMITED, of 344 Selbourne Road, Luton, Bedfordshire, a British Company, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statements:—

This invention relates to a rack bar and pinion assemblies and is particularly suitable for rack bar and pinion assemblies of the kind as used in steering gears.

A rack bar and pinion assembly of the kind with which the present invention is concerned includes a pinion rotatively mounted in a pinion housing; a rack bar linearly movable in a longitudinal direction through said pinion housing; and a rack on said rack bar operatively connected with the pinion so that rotation of the pinion effects movement of the rack bar through the pinion housing.

It has hitherto been proposed to provide a support member on which the rack bar is supported in the pinion housing, the support member being situated between the pinion housing and the rack-bar and located at a position on the rack bar on the side remote from the rack.

Previously the support member has been in the form of a yoke with which the rack bar was in sliding contact. However, it is found that the frictional forces developed by sliding contact between the yoke and rack bar on this kind of assembly causes considerable wear to the relevant contact surfaces and thus reduces the efficiency of the rack bar and pinion assembly.

It is an object of the present invention to provide a rack bar and pinion assembly in which the frictional forces developed by contact between the rack bar and support member are reduced, thereby relatively decreasing wear to the relevant contact surfaces to increase the efficiency of the assembly.

It is a further object of the present invention to provide a rack and pinion assembly of the kind specified in which the rack bar is supported in a manner to restrain lateral movement of the rack bar relative to the pinion.

According to the present invention there is provided a rack bar and pinion assembly of the kind specified which includes a support assembly adapted to support the rack bar to maintain the rack and pinion in engagement which comprises a roller member and a roller carrier which rotatably supports the roller member, the roller member being supported by the roller carrier to be capable of rotational movement about an axis which is stationary relative to the roller carrier; the support assembly being situated between the pinion housing and the rack bar on the side of the rack bar remote from the rack, with the roller member located between the roller carrier and the rack bar, wherein the roller carrier is slidable in the pinion housing in a direction substantially normal to the direction of movement of the rack bar and is resiliently mounted relative to the pinion housing to bias the support assembly in a direction towards the rack bar whereby the roller member is urged against the rack bar on the side thereof remote from the rack so that the roller member rotates in sympathy with the rack bar about said stationary axis during movement of the rack bar through the housing over the roller member.

In a preferred form of construction the support assembly engages with the rack bar to provide lateral support to the rack bar whereby lateral movement of the rack bar is restrained in a direction which is substantially normal to both the longitudinal direction of

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movement of the rack bar through the pinion housing and the direction of sliding movement of the roller carrier in the pinion housing.

Further according to the present invention there is provided a steering gear which incorporates a rack bar and pinion assembly constructed according to the present invention.

It will be realised that the term roller member as used herein includes a ball, reel, waisted roller or cylinder.

Several embodiments of the present invention will now be described, by way of example only, and with reference to the accompanying diagrammatic drawings, in which:—

Fig. 1 illustrates a cross section taken normal to the longitudinal axis of the rack bar of a rack bar and pinion assembly according to the present invention in which the roller member is in the form of a ball;

Fig. 2 illustrates a detail of a rack and pinion assembly similar to that illustrated in Fig. 1 in which the roller member is in the form of waisted roller;

Fig. 3 illustrates a detail of a rack and pinion assembly similar to that illustrated in Fig. 1 in which the roller member is in the form of a reel; and

Fig. 4 illustrates a detail of a rack and pinion assembly similar to that illustrated in Fig. 1 in which the roller member is in the form of a cylinder.

Referring firstly to Fig. 1 which illustrates a rack and pinion assembly of the kind specified, a pinion 1 is rotatably mounted on bearings 2 in a pinion housing 3. The pinion 1 can be rotatably driven by a shaft 4. The pinion 1 engages with a rack 5 of a rack bar 6 so that rotation of the pinion 1 effects in linear movement of the rack bar 6 in a longitudinal direction through the pinion housing 3.

The rack and pinion assembly incorporates a support assembly indicated generally at 7 which in the present embodiment, comprises a ball 8 and a ball carrier 10. The ball 8 is located between a recess 9 in the ball carrier 10 and a longitudinally extending complementary groove 11 in the rack bar 6. The groove 11 is formed in the rack bar 6 at a position diametrically opposite or on the side remote from the rack 5. The ball carrier 10 is slidable in the pinion housing in a direction normal to the direction of movement of the rack bar and is resiliently mounted relative to the pinion housing 3 to bias the ball 8 towards and into contact with the rack 6. In the present examples the roller carrier is urged towards the rack bar 6 by spring means 12 located between the roller carrier and the pinion housing 3 to increase the support effected by the roller member. It will be realised that alternative resilient mountings, for example rubber, can be used.

In operation of the rack bar and pinion assembly illustrated in Fig. 1, as the rack bar 6 is moved through the pinion housing 3 by rotation of the pinion 1 the ball 8 rotates in sympathy with the rack bar 6 and rotates about an axis which is stationary relative to the ball housing 10 whilst support is provided on the rack bar 6. The engagement between the ball 8 and the groove 11 provides support to the rack bar in a sense which restrains lateral movement thereof relative to the pinion 1.

In the embodiments illustrated in Figs. 2 to 4, for convenience of description, similar parts of the rack bar and pinion assemblies are accorded the same reference numberals as used in the embodiment illustrated in Fig. 1.

Referring now to Fig. 2 the roller member is in the form of a wasted roller 13 located between the rack bar 6 and a roller carrier 14 having a support surface 14*a*. The waisted roller 13 is seated in the form of a saddle which is stationary relative to the carrier 14 and if required the roller 13 can be pinned at 15 to the carrier 14 for rotation about its axis. It is possible to eliminate the pinning by suitably shaping the support surface 14*a* of the spool carrier 14 on which the waisted roller 13 is seated in the form of a saddle which is complementary to the concave surface of the roller 13. It is seen that the concave form of the waisted roller 13 is complementary to the convex form of the part of the rack bar 6 with which it engages. The roller 13 is urged towards and contacts the rack bar 6 under the action of the spring means 12 and rotates during movement of the rack bar in the manner above described. The engagement between the concave surface of the roller 13 and the convex form of the rack bar 6 provides support to the rack bar in a sense which restrains lateral movement thereof relative to the pinion 1.

In Fig. 3 the roller member is in the form of a reel 16 which is located between the rack bar 6 and a reel carrier 17 having a support surface 17a. The peripheral recess 16*b* of the reel 16 engages with a complementary longitudinally extending rib 16*a* machined on the rack bar at the side remote from the rack 5. Similarly to the embodiment in Fig. 2 the reel 16 is mounted for rotation about an axis which is stationary relative to the reel carrier 17 and if required the reel can be pinned at 18 to the reel carrier 17 for rotation about its axis. Conversely, the support surface 17*a* of the reel carrier 17 can be of arcuate cross-section to provide a concave surface complementary to the convex surface of the reel 16 to retain the reel 16 without pinning The engagement between the rib 16*a* and the reel 16, that is with the rib located in the peripheral recess 16*b*, provides support to the rack bar in a sense which restrains lateral movement thereof relative to the pinion 1.

In Fig. 4 the roller member is shown in the form of a cylinder 19 located between a longitudinally extending flat 20 machined on the rack bar 6 and a cylinder carrier 21 having a support surface 21*a*. Similar to the embodiment shown in Fig. 3 the peripheral surface of the cylinder 19 abuts the flat 20 and the cylinder 19 can be pinned at 22 to the carrier 21 for rotation about its axis or conversely the support surface 21*a* of the carrier 21 can be of arcuate cross-section to provide a concave surface complementary to the convex surface of the cylinder 19 to retain the cylinder 19 so that during its rotation the cylinder 19 rotates about an axis which is stationary relative to the cylinder carrier 21.

It will be realised that several modifications are possible to the above described embodiments without departing from the scope of the present invention as defined in the appended claims, for example, the rack bar can be of a cross section other than circular, the resilient mounting of the roller carrier can be of a form other than springs, either or both means as above described of retaining the roller member in the roller carrier (i.e. the pinning or the complementary formation of the support surface) can be used as required.

WHAT WE CLAIM IS:—

1. A rack bar and pinion assembly of the kind specified which includes a support assembly adapted to support the rack bar to maintain the rack and pinion in engagement which comprises a roller member and a roller carrier which rotatably supports the roller member, the roller member being supported by the roller carrier to be capable of rotational movement about an axis which is stationary relative to the roller carrier, the support assembly being situated between the pinion housing and the rack bar on the side of the rack bar remote from the rack, with the roller member located between the roller carrier and the rack bar, wherein the roller carrier is slidable in the pinion housing in a direction substantially normal to the direction of movement of the rack bar and is resiliently mounted relative to the pinion housing to bias the support assembly in a direction towards the rack bar whereby the roller member is urged against the rack bar on the side thereof remote from the rack so that the roller member rotates in sympathy with the rack bar about said stationary axis during movement of the rack bar through the housing over the roller member.

2. A rack bar and pinion assembly as claimed in claim 1 wherein the support assembly engages with the rack bar to provide lateral support to the rack bar whereby lateral movement of the rack bar is restrained in a direction which is substantially normal to both the longitudinal direction of movement of the rack bar through the pinion housing and the direction of sliding movement of the roller carrier in the pinion housing.

3. A rack bar and pinion assembly as claimed in claim 2 wherein the lateral support of the rack bar is provided by engagement between complementary shaped surfaces on the rack bar and roller member.

4. A rack bar and pinion assembly as claimed in any one of the preceding claims wherein the roller carrier is resiliently mounted on spring means.

5. A rack bar and pinion assembly as claimed in any one of the preceding claims wherein the roller carrier is provided with a support surface which is formed complementary to the surface of, and carries, the roller member so that the roller member is located in the pinion housing on the support surface and the surface of the roller member slides over the support surface during rotation.

6. A rack bar and pinion assembly as claimed in any one of the preceding claims wherein the roller member is pinned to the roller carrier for rotation about its axis.

7. A rack bar and pinion assembly as claimed in any one of claims 1 to 5 wherein the roller member is a ball carried on the roller carrier and mounted for rotation in a recess in the roller carrier, the rack bar being provided with a longitudinally extending groove complementary to and engaging with the ball.

8. A rack bar and pinion assembly as claimed in any one of claims 1 to 6 wherein the roller member is a waisted roller the concave surface of which is complementary to the convex surface of the rack bar.

9. A rack bar and pinion assembly as claimed in claim 8 when dependent on claim 5, wherein the support surface of the roller carrier is in the form of a saddle which saddle is complementary to the concave surface of the waisted roller.

10. A rack bar and pinion assembly as claimed in any one of claims 1 to 6, wherein the roller member is a reel having a peripheral recess which engages with a longitudinally extending, complementary rib provided on the rack bar.

11. A rack bar and pinion assembly as claimed in claim 10 when dependent on claim 5, wherein the support surface of the roller carrier is of arcuate cross-section to provide a concave surface complementary to the convex surface of the reel.

12. A rack bar and pinion assembly as claimed in either claim 1 or claim 2, wherein the roller member is a cylinder, the peripheral surface of which abuts an axially extending flat provided on the rack bar.

13. A rack bar and pinion assembly as claimed in claim 12 wherein the roller carrier has a support surface which carries the

cylinder, the support surface being of arcuate cross-section to provide a concave surface complementary to the convex surface of the cylinder.

14. The rack bar and pinion assembly substantially as herein described with reference to Fig. 1 of the accompanying diagrammatic drawings.

15. The rack bar and pinion assembly substantially as herein described with reference to Fig. 1 when incorporating the modification substantially as herein described with reference to Fig. 2 of the accompanying diagrammatic drawings.

16. The rack bar and pinion assembly substantially as herein described with reference to Fig. 1 when incorporating the modification substantially as herein described with reference to Fig. 3 of the accompanying diagrammatic drawings.

17. The rack bar and pinion assembly substantially as herein described with reference to Fig. 1 when incorporating the modification substantially as herein described with reference to Fig. 4 of the accompanying diagrammatic drawings.

18. Steering gear which incorporates a rack bar and pinion assembly as claimed in any one of the preceding claims.

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1 SHEET This drawing is a reproduction of the Original on a reduced scale

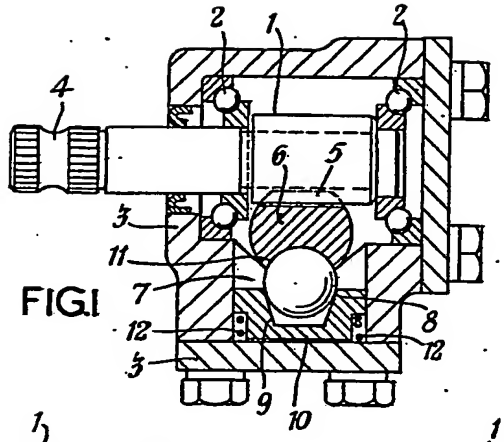

FIG.1

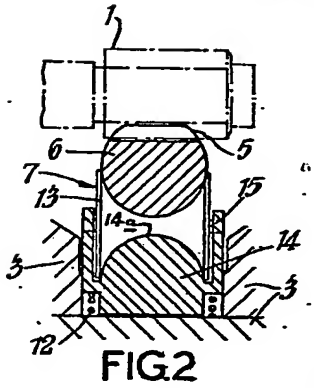

FIG.2

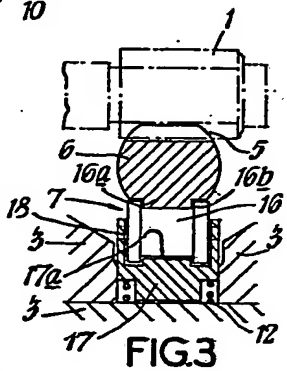

FIG.3

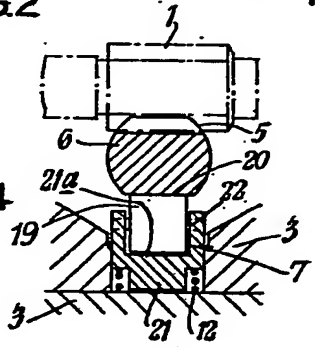

FIG.4